DOCUMENT RESUME

ED 448 194 TM 032 155

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TITLE Student Course-Taking Delivered through a High School Block Schedule: The Relationship between the Academic Core and Student Achievement.
PUB DATE 2000-11-00
NOTE 43p.; Paper presented at the Annual Meeting of the Mid-South Educational Research Association (28th, Bowling Green, KY, November 15-17, 2000).
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Academic Achievement; *Block Scheduling; *Core Curriculum; *Course Selection (Students); *High School Students; High Schools; *Time Factors (Learning)

ABSTRACT

The hypothesis of this study was that student course-taking on the block schedules contributes to the comprehensive nature of the high school and the differentiated curriculum. Because of the shift of time associated with the block schedule, it was hypothesized that students would spend significantly less time studying the core academic curriculum, and more time studying noncore subjects. The study also hypothesizes the amount of time a student spends studying the academic core curriculum is a predictor of success on a test of postsecondary readiness. A proportional stratified random sample of 288 transcripts was selected from the graduating classes of one high school with a recently adopted alternating day A/B block schedule and one high school using a 4x4 semester block schedule. The results call into question the importance of the delivery of curriculum evolving with the implementation of block scheduling. In these schools, the block schedule has created a time shift, rather than a credit shift, away from core academic subjects to elective areas. The regression indicates that this time shift can be harmful to student achievement since the hours spent studying the academic core proved to be a strong predictor of success on tests like the ACT Assessment. While the raw achievement data are mixed, a general decline in test scores is evident in mathematics, especially among students studying a rigorous precollege curriculum. Schools that embrace block scheduling to increase achievement by adjusting the learning time are using the block schedule as it was intended to be used, but those that are using block scheduling to give students increased opportunities to take electives are putting aside a rigorous academic curriculum. Four appendixes contain graduation requirements for both schools, school day schedules, ACT scores for both schools, and regression analysis tables. (Contains 6 tables and 53 references.) (SLD)

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Running Head: THE CORE AND ACHIEVEMENT ON A BLOCK SCHEDULE

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Student Course-Taking Delivered through a High School Block Schedule: The Relationship between the Academic Core and Student Achievement

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Abstract

This study examines high school student course-taking trends and achievement as a result of the curriculum delivered in two forms of "block" scheduling compared to a traditional schedule to determine (a) if students are spending a significant amount of time studying subjects not in the academic core curriculum as a result of the choice a block curriculum gives students, (b) if the amount of time a student spends studying a core curriculum can successfully predict their post-secondary readiness, and (c) the course-taking trends that emerge as a result of the block curriculum compared to the curriculum associated with a traditional schedule. The researcher analyzed nearly 300 transcripts from the graduating classes of 1995 and 2000 at two high schools tracking the hours students studied core academic subjects and elective subjects, including vocational and technical courses. Measures of academic achievement included (a) grade-point average, (b) class rank, (c) pre-college aptitude test. Each school operated on a six-period traditional schedule in 1995 and switched to a version of block scheduling in 1996. School A uses an alternating day 1/ day 2 schedule or A/B schedule, School B uses a 4 x 4 semester block schedule. The results indicate a significant decrease in the amount of time students spend studying core academic subjects and significantly more time in elective classes on the block compared to a traditional schedule. The amount of time students spend in the academic core also strongly predicts a student's level of achievement. These findings suggest that the block schedule has led to increasingly more curriculum differentiation than a traditional schedule. There are significant implications for curriculum development and course offerings on a block schedule at the high school level.

Student Course-Taking Delivered through a High School Block Schedule: The Relationship between the Academic Core and Student Achievement

Introduction

Background

During the 1980s, block scheduling has become increasingly popular in U.S. high schools. In just the four-year span between 1992 and 1995, the proportion of U. S. high schools on block schedules rose from 4 percent to over 40 percent (Block Scheduling in Texas Public High Schools, 1999). Although there are numerous types of block schedules, all are intended to enhance the student learning experience by providing longer periods of instructional time. Proponents of block scheduling claim that it reduces fragmentation of instruction, accommodates more effective teaching practices, and expands opportunities for individualized instruction. Critics maintain that instructional time over the school year is actually reduced; teacher and student concentration is weakened over a 90-minute period; and learning retention is undermined by gaps between sequential courses. To date, research on the effects of block scheduling has shown very mixed results in key areas of student achievement.

Scope of this Paper

This study focuses on connecting the issue of time-reduction to student achievement on two variations of block scheduling compared to a traditional schedule. The emphasis is based on a transcript study of the following:

(1) The time students study the academic core on a block schedule compared to a traditional schedule;

(2) Student course-taking preferences, given the increased number of elective classes they can take on the block compared to a traditional schedule; and

(3) The connection between the amount of time a student spends studying the academic core and their achievement on a test of post-secondary readiness.

Types of Block Scheduling

The term "block scheduling" broadly refers to scheduling practices that organize at least part of the school day into larger blocks of time (more than 60 minutes) but for fewer than the traditional number of days. Introduced in the mid-1960's, the concept is rooted in concerns about creating sufficient learning time for students. An extended-period schedule contains fewer classes per day, enabling teachers and students to focus more time to teach subjects in more depth. Most proponents feel these techniques will ultimately increase student motivation and, ultimately, improve student achievement.

The "traditional schedule" refers to the single-period daily schedule where students take six, seven, or eight classes each day for between 40 and 60 minutes throughout the school year. This type of schedule remains the most widely used form of scheduling in the U. S. Canady and Rettig (1995, pp 23-27) identify several basic designs of the more commonly used block schedules. The two most common, the 4 x 4 and the A/B, are the subject of this study.

The 4 x 4 (accelerated or semester) schedule divides the standard 180-day school year into two 90-day semesters. Each semester, students attend four 90-minutes classes daily. Instruction that had previously stretched over the course of an entire 180-day

school year is now compressed into one semester of 90-minute periods. Teachers generally instruct for three of the periods and have a fourth block for planning each day. The major advantage of the 4 x 4 is its flexibility, designed to meet the particular needs of the school and community. It is also very student and teacher-friendly in that it reduces the load of both to three or four classes each semester. The major drawback of the 4 x 4 is the delivery of performance music, journalism, and Advanced Placement classes.

In the A/B (day 1/day 2 alternate) schedule, students attend eight extended classes that meet every other day throughout the school year. Students receive the same number of instructional hours on the A/B as on the 4 x 4, just spread out over the course of the 180-day year rather than in 90-day doses each semester. As with the 4 x 4, teachers instruct for three periods each day and have a fourth 90-minute period for planning time. The major advantage of the A/B schedule is the spacing of instruction over the course of the 180-day school year, rather than condensed into 90-days. The major drawbacks are the load of classes carried by students and teachers increases with the A/B schedule to eight for a student and six for a teacher. The retention of information over alternating days is also a concern expresses by some teachers on the A/B schedule.

Review of Literature

The study of time and student learning has been a consistent strand of educational research for the past several decades. Since the landmark 1983 report, A Nation at Risk suggested, among other things, increasing the amount of time students spend in school, educators have grappled with the issue of how to increase student learning time. Comparisons of the number of annual instructional hours American students receive in core academic areas are considerably below that of their European and Japanese

counterparts (Prisoners of Time, 1994). During the final four years of school the average U.S. student spent 1,460 hours studying core academic subjects, while students in Japan spent 3,170 hours, French students spent 3,280 hours, and Germans spent 3,628 hours studying the academic core curriculum (Prisoners of Time, 1994). Studies have been mixed on whether or not increased time has a positive impact on student achievement. Several studies have indicated that increasing the amount of time available for learning and making learning more productive are keys to improving learning (Walberg, 1993). Several earlier studies, including Seifert and Beck (1983), Gettinger and White (1979), Christoffersson (1971) indicate a strong positive relationship between time and learning. Adelman and Pringle (1995) cite studies where an increase in the length of the school year or school day showed mixed results. The same review also discussed the merits of the "less-is-more" hypothesis of actually decreasing time led to positive student performance.

The most significant case study that correlates to the hypothesis in this study is from a Boston middle school that since 1985 has offered 90 more instructional minutes on four out of five school days than other district schools. The school, which serves many lower socio-economic students, used the added instructional time for reading and math allowing all students access to homework assistance. The result was a significant improvement in test scores and an improved acceptance rate of its students to selective "examination" high schools (Adelman et al., 1996). While these studies advocate a better use of time and improved quality of instruction, never the less, they indicate that increased time in the classroom can lead to high academic achievement.

Few studies of the impact of increased or decreased time on student achievement focus specifically on time in a block schedule. However, several studies on student achievement and the block schedule address the issue of the sequencing of courses due to the decrease in time that results with the block schedule. Many of the studies also focus on the gaps created with a semester block system such as the 4 x 4. The most revealing studies come from Canada, where their schools have been on a semester block schedule since the 1980's. In a large-scale study, Bateson (1990), as part of the Provincial Science Assessment in British Columbia, looked specifically at science achievement in Grade 10 classes. He compared results between semester block schools and all-year schools. His sample size was also large, with over 30,000 students completing the assessments, 65% on an all-year format and 28% on a semester block format. He reported his results in the Journal of Research in Science Teaching as follows:

> It was found that, contrary to reported teacher perceptions of semester versus all-year courses, students in the all-year course consistently outperformed both first- and second-semester students in the domains tested. (Bateson, 1990, p. 233)

Marshall and others extending the study to include mathematics as well replicated the Bateson study in 1995. While the results were not as strong as Bateson's study, both subject areas did show that students studying science and math on an all-year format outperform students on a semester block format.

Raphael and others (1986) in a similar study evaluated 250 classes in 80 Ontario schools found that student achievement in mathematics as measured by the Second International Mathematics Study resulted in "greater achievement and attitude toward mathematics" for students in year-long classes. Raphael and Wahlstrom (1986) reported similar results from the Second International Science Study of students in biology,

chemistry and physics. Gore (1996) analyzed the performance of British Columbia students on the grade 12 Provincial Exams and found that full-year students outperformed block schedule students in every subject. Kramer (1997) indicates that many of the Canadian studies have been criticized because of the timing of the assessments. Students were generally tested in May when many second semester block students have yet to complete their coursework. Kramer goes on to suggest that the following "overall pattern of scoring somewhat mitigates this limitation" (p 30).

A few U.S. studies in mathematics and science are reporting similar results for students on a 4 x 4 schedule indicating a need to adjust course sequences and gaps that result from semester schedules. Wronkovich (1997) evaluated students on the Ohio Early Mathematics Placement Test (EMPT) from students in demographically similar suburban Ohio school districts, one using a 4 x 4 and the other a traditional schedule. Differences in aptitude were considered using the math aptitude score from the PSAT/NMSQT math test and using cumulative high school GPA. The students in the block program showed a 20% drop in academic performance associated with the block. Black (1998), in his study of a Colorado school as cited in (Wild, 1998) writes:

> measures such as SAT and ACT…are at a standstill or even losing ground. Such mixed results question whether block scheduling boost student achievement.-(p 34)

While the numerous large scale studies, such as those cited above, report decreases in achievement on block schedules, there are several small-scale studies reporting very mixed results. The best achievement data currently available come from North Carolina. Semester block scheduling appears to have had an overall positive effect in North Carolina. Averett (1994) summarized the change in test scores at a large

number of schools in North Carolina that switched from a traditional schedule in 1992-93 to a semester block schedule in 1993-94. He used standardized end-of-course examinations in five subjects (Algebra II, English I, Geometry, Legal and Political Systems, and U.S. History). Overall, his data indicated that switching to a semester block schedule had either no effect or a slightly positive effect on achievement in these five subject areas. His study mentions this as a positive result, since the clock hours of each subject decreased from between 150 and 165 to 135.

A comprehensive Texas study (1999) examined the relationship between different types of schedules and overall student performance in Texas public high schools. Overall, student performance was measured in terms of dropout rates, grade-level retention rates, campus-level results for the Texas Assessment of Academic Skills (TASS), and participation and performance on college admissions tests (SAT and ACT) and AP examinations. The findings suggest that school context, such as curriculum delivery and quality of instruction is much more closely related to overall student performance than the particular types of schedule high schools used.

Lockwood (1995) reports in a study of Alabama schools that no significant difference in the achievement of students in algebra and geometry on the two schedules. Numerous studies (Einender and Bishop, 1997; Edwards, 1995; Salvaterra & Adams, 1995; Guskey and Kifer, 1995; Hackman, 1995; Fletcher, 1997; O'Neil, 1995) have reported that students were more likely to earn higher grades point averages, or be on the honor roll after their high schools introduced block scheduling. Many of the same studies have also reported improvements in school attendance rates, dropout rates, and disciplinary referrals.

The College Board, which oversees the Advanced Placement (AP) program, has conducted studies (1996 & 1998) on the student performance on AP examinations on the semester block, an extended block (between 60-90 minutes daily), and a traditional schedule. Under the block, AP exam scores for calculus, U.S. history, and the sciences drop on the average by 0.6 points on a five-point scale, a 20% reduction. In each subject studied students in yearlong AP courses and yearlong block AP courses earned higher grades on AP exams. In most cases, students on the semester block earned similar grades on exams when they took the course in the fall semester compared to the spring semester.

At present, too little information is available to draw conclusions about the effects of an alternating day block schedule on student achievement results. Only four schools with alternating day block schedules reporting testing results. Two reported improvements, one reported no change, and one reported a decrease after switching to the block schedule (Cameron, 1995; Hilcrest HS, 1995; Sessoms, 1995; Sturgis, 1995 as cited in Kramer, 1997).

A major focus of this research is the preferences of students in the selection of courses due to the increased opportunity to take elective classes on the block schedule. Several studies of American high school graduates emphasize the importance of the core curriculum, student achievement, and the very nature of the American comprehensive high school. The most recent study to address the rigor of the core curriculum in high school came from the U.S. Department of Education. Adelman (1999) found that the intensity of the high school curriculum was the strongest predictor of a student's success in post-secondary education and degree attainment. Of all the core academic curricula, the highest level of mathematics a student studies in secondary school has the strongest

continuing influence on bachelor's degree completion. Finishing a course beyond the level of Algebra II, such as trigonometry, or pre-calculus doubles the odds that a student who enters post-secondary education will complete a bachelor's degree.

Several classic studies of American high schools in the 1980s criticize the comprehensive nature of the American high school that resulted from the differentiation of curriculum in the post-World War II period. Powell, Farrar, and Cohen in The Shopping Mall High School (1985) describe the main strategy for accommodating and keeping happy the large and varied group of students served by comprehensive high schools. High school students and teachers say with pride, they provide "something for everybody." Students are not pushed to choose wisely among the educational opportunities. This lack of push, they claim, is a strategic accommodation that schools make in order to keep peace. Students who wish to avoid learning can still usually manage to graduate. The Shopping Mall High School was one of three books published from A Study of High Schools, an inquiry into the state of American secondary education conducted from 1979 to 1984 with qualitative and quantitative observation of 15 secondary schools over the 1981-82 academic-year. Hampel's The Last Little Citadel (1986), the second volume of the study, is a series of essays on the history of the American high school since 1940 chronicling the periodic efforts to change high schools that always resulted in failure.

The other volume of the trilogy, Sizer's Horace's Compromise (1984), illustrates the life of a fictional teacher, Horace Smith and the compromises he makes between what he knows he needs to do and what he can do to effectively teach the students English in his high school. Sizer later added two additional volumes to the story of Horace Smith

and his high school. One of Sizer's simplest conclusions and later a cornerstone of his Coalition of Essential Schools movement is that high schools should not attempt to be "comprehensive" if such a claim is made at the expense of the school's central intellectual purpose. An Essential School should not attempt to provide an unrealistically wide range of academic, vocational programs for adolescents (p 225).

A Nation at Risk (1983) also cited the differentiated curriculum offered in American high school as a contributor of the rising tide of educational mediocrity, claiming that most high schools offered a "cafeteria-style" curriculum (National Commission on Excellence in Education, 1983, pp 18-19). To correct these problems the report advocated a program of "New Basics," a required core of academic courses for all students. A uniform curriculum, such as that advocated by Adler (1982), is part of an on-going historical dispute on the nature of the American high school (Ravitch, 1985).

Various U.S. Department of Education transcript studies and an exhaustive historical analysis of student course-taking (Angus and Mirel, 1999; West, Diodata, and Sandberg, 1984; and National Center for Education Statistics studies in 1982, 1987, 1990, and 1994) document the prevalence of the differentiated curriculum in high schools despite some increases in graduation requirement in some states. In many cases the increase of graduation requirements have resulted in a "bait and switch" in which courses with academic titles simply mask watered-down content (Angus and Mirel, 1999, p 200).

Hypotheses

It is the hypothesis of this study that student course-taking on the block schedule contribute to the comprehensive nature of the high school and the differentiated curriculum. Due to the shift of time associated with the block schedule, students will

spend significantly less time studying the core academic curriculum and significantly more time studying non-core subjects such as art, physical education, and technical/career education. The study also hypothesizes that the amount of time a student spends studying the academic core curriculum in high school is a powerful predictor to their success on a test of post-secondary readiness.

Methodology

Participants

A proportional stratified random sample of 288 transcripts was selected from the graduating class of 1995 and 2000 at two high schools. High School A used a traditional six-period day until 1995 and adopted an alternating day A/B block schedule in 1996. High School B also used a traditional six-period day until 1995 and adopted a 4 x 4 semester block schedule in 1996. The graduating Class of 2000 at both high schools is the first class to study on the block for all four years of high school.

Because the block schedule has radically changed the way time is used at the high school, time rather than credits are the focus of the analysis. The amount of time allocated to a credit has changed from 174 hours per course on a six period day to 130.5 hours per course on both four-period varieties of the block schedule. The amount of time a student spends in school remained constant from 1995 to 2000 at 1,050 hours per year, or 4,200 hours per four years of high school.

The sample collected included between 10-15 percent of graduates in three strata of diploma classification awarded by the schools. In 1995 and 2000, School A used a student self-tracked system with three diploma levels: honors, college prep, and regular.

School B used a self-tracked system with four diploma levels in 1995: honors, college prep, advance comprehensive, and regular. In 2000, School B eliminated the regular and advanced comprehensive track and grouped all classes at the college prep or honors level. School B still offered a basic diploma, based on the courses taken rather than the ability grouping of the class. The graduation requirements of both high schools for 1995 and 2000 are included in Appendix A.

Both schools are classified as traditionally high performing academic schools. Their ACT mean score over the last 10 years has been higher than the state mean and similar to the national mean. Both schools earned the distinction of being State Blue Ribbon Schools; one has been named a National Blue Ribbon School. Each draws from a combination of rural and suburban students in a medium-sized town. Both schools are relatively homogenous ethnically, comprised of 95 percent white (non-Hispanic) students. School A served 27 percent of students through the free and reduced lunch program, while School B served 14 percent in 2000. The demographics of both schools did not significantly change between 1995 and 2000.

Instruments

The official high school transcript provided documentation of the courses students enrolled in during the four years of high school. The student handbook served as verification of how long the instructional time was for each schedule (Appendix B contains the bell schedules). The student achievement data was taken from the student label on the back of the transcript. Measures of academic achievement included (a) pre-

college aptitude test (b) grade-point average, and (c) class rank. The following tests were used as pre-college aptitude tests, or tests of post-secondary readiness:

(1) PLAN, a pre-ACT test that correlates very highly with the ACT given during grade 10,

(2) PSAT, a pre-SAT test used as the National Merit Qualifying Test given at grade 11,

(3) ACT or SAT tests given at grades 11 or 12. If a student took these tests multiple times, the highest scores were used.

Since not all students took all tests, scores on each were converted to T-scores so they could be uniformly compared. Of the 288 transcripts analyzed, 248 included some type of test of post-secondary readiness, 119 from 1995 and 129 from the class of 2000. The ACT is the most used test with 211 scores, 109 from 1995 and 102 from the class of 2000. The difference between the population mean ACT score and the sample mean ACT score was less than a point in both English and mathematics at each school. Both schools saw a slight increase in the proportion of students taking the ACT between 1995 and 2000. School A saw the largest increase from 56 percent in 1995 to 72 percent in 2000. School B increased from 67 percent in 1995 to 76 percent in 2000. This increase could be attributed to a newly instituted state scholarship awarded to all students making a GPA of 2.5 or higher. Monetary incentives from this scholarship are awarded for ACT scores above a 16.

Procedures

The randomly sampled student transcripts were analyzed uniformly according to the following criteria:

(1) Time spent studying the academic core and non-academic core is defined in terms of the student being registered for the course for high school credit, regardless of the grade or credit earned by the student.

(2) The time students spent studying the academic core or non-core on a traditional schedule is based on a 58-minute period meeting for 36 weeks or 180 days with a total of 174 hours per credit and 82.5 hours per half credit.

The time students spend studying the academic core or non-core on a block schedule is based on an 87-minute period meeting for 18 weeks (meeting each day) on the 4 x 4 schedule or 36 weeks (meeting every other day) on the A/B schedule. Each block schedule consists of 130.5 hours per credit course and 62.25 hours per half credit course.

The core academic curriculum is defined as any state required course for graduation in English, mathematics, science, social studies, and the required credit in health and physical education. Other core academic courses include foreign language, and elective credits in journalism, literature, history, psychology, sociology, government, economics, humanities or fine arts appreciation, speech, drama, mathematics, science, foreign language, and Advanced Placement courses in any of the above subjects.

The non-academic core curriculum includes any courses not part of the core academic curriculum defined above. The non-core is broken into five sub-categories for the purpose of this study. Vocational, technical or career courses include business, family and consumer science, agriculture, industrial arts, technology education, typing, keyboarding, computer courses, and career prep and co-op courses. Music includes band, orchestra, choir, music appreciation, and AP music theory. Art includes any course in the

visual arts, including AP art studio. Physical education includes any physical education or health credit taken in addition to the state required credit in health and physical education. Other electives includes school-based required courses outside of the core such as personal development, driver education, yearbook, senior project, community service, or other elective classes not part of the previously defined academic core that do not fit into any of the sub-categories listed above.

Analysis of Data

A one-way analysis of variance was used to analyze the difference between the amount of time students spend studying the core and the non-core on a traditional versus a block schedule. A multiple linear regression model with step-wise selection was used to show the predictive power of time spent studying the academic core on a post-secondary readiness test. All assumptions were met for each analysis.

Results

The first phase of the analysis deals with the differentiated curriculum of the block schedule compared to the traditional schedule. The analysis of variance indicates that students in the Class of 2000 of the semester (4 x 4) and day 1/ day 2 (A/B) block schedules spend significantly less time studying core academic subjects than their counterparts in the Class of 1995. It also revealed that students in the Class of 2000 at both schools spent significantly more time studying technical, art, physical education, and other elective subjects. Table 1 summarizes the time spent in the core, non-core, and in each area of the non-core curriculum.

Table 1

Hours Spent Studying the Core and Non Core

School	Hours Core		Hours Non-Core		Hours Technical Core	
Year	1995	2000	1995	2000	1995	2000
A (A/B)	3005	2637	1112	1364	863	1229
B (4 x 4)	3193	2894	1007	1282	623	893
Total	3055	2778	1060	1319	744	1044

Table 1. Continued

Hours Spent Studying the Core and Non Core

School	Hours Art		Hours PE		Hours Music	
Year	1995	2000	1995	2000	1995	2000
A (A/B)	58	128	63	149	45	89
B (4 x 4)	64	258	133	220	75	54
Total	61	200	100	188	60	70

Table 2 summarizes the results of the analysis of variance between the time-spent studying the core academic curriculum on both variations of the block schedule compared to the traditional schedule. While both are statistically significant, it is hard to compare one schedule to other based on these data. The delivery of curriculum and instruction within each variety of schedule is a significant variable that differs greatly from School A to School B. For example, School B (4 x 4) offers algebra I to selected students using a full-year format (every day for two semesters), while School A offers algebra I to all students on the alternating day block without modifications. School A also offers courses that are grouped based on student ability and diploma level. School B offers every course at either the college prep or honors level.

Table 2

Analysis of variance between time spent in the core on block vs. non-block

ANOVA Sources	df	Mean Square	F Ratio	p Value
Core Hours A (A/B)	128	235400.09	18.66	.000**
Core Hours B (4 x 4)	156	275279.96	12.84	.000**
Core Hours Total	286	268060.19	29.16	.000**

**p < .01
*p < .05

The disaggregated data shows the shifting of time from the academic core to three primary areas of non-academic study. There is a great deal of variance from School A to School B on which areas benefit the most from the shift from academic to non-academic. Students at School A may have more students spending time in technical while at School B students spend more time in art. These differences are attributed to the instructional and programmic differences from one school to the other rather than the schedule. However, the shift from academic to non-academic in general may be a result of the block schedule at both schools.

Music, which resulted in increased time at School A and decreased time at School B, is the only non-core subject that may be the result of the different variations of the block schedule. Various studies (Blocher & Miles, 1995; Hall, 1992) have documented the difficulties the music and band programs have experienced on semester block schedules. School B (4 x 4) schedules band as a two-credit course running the length of the year. Students are forced to spend eight credits, or one-fourth of their high school credits, if they want to be completely involved with performance music courses for all four years of

high school. Many students, such as those in the honors track, cannot afford to dedicate that many credits to performance music courses and lose the opportunity to take weighted honors and AP courses that will improve their class rank. The music situation is completely different on the A/B schedule. Students spend only one credit per year and a smaller proportion of overall credits in music.

Table 3 summarizes the results of the analysis of variance between time-spent in non-core subjects overall and on each variation of the schedule. With the exception of music, there is a statistically significant increase in the time spent studying each area on the block schedule.

Table 3

Analysis of variance between time spent in non-core subjects on block vs. non-block

ANOVA Total	df	Mean Square	F Ratio	p Value
Art Hours	277	51420.88	27.06	.000**
PE Hours	277	56579.03	10.41	.001**
Music Hours	277	41777.07	.267	.606
Tech. Hours	277	374409.45	20.57	.000**

**p < .01

Table 3. Continued

Analysis of variance between time spent in non-core subjects on block vs. non-block for School A

ANOVA A (A/B)	df	Mean Square	F Ratio	p Value
Art Hours	131	26796.90	6.50	.012*
PE Hours	131	34476.50	7.07	.009**
Music Hours	131	40759.15	1.74	.189
Tech. Hours	131	360335.48	14.9	.000**

**p < .01
*p < .05

Table 3. Continued

Analysis of variance between time spent in non-core subjects on block vs. non-block for School B

ANOVA B (4 x 4)	df	Mean Square	F Ratio	p Value
Art Hours	157	65930.81	22.67	.000**
PE Hours	157	70741.89	5.08	.026*
Music Hours	157	44550.56	.480	.489
Tech. Hours	157	336458.54	13.38	.000**

**$p < .01$
*$p < .05$

The second phase of this analysis attempts to determine if the decreased amount of time that students spend studying the academic core because of block scheduling has an impact on student achievement, and if the amount of time a student spends studying the core can predict performance on a test of post-secondary readiness.

Descriptive statistics show a slight difference in student achievement on tests of post-secondary readiness favoring the Class of 1995 over the Class of 2000 at each school. While the overall data show little difference, disaggregated data show larger differences based on the diploma level of the student. Table 4 summarizes the descriptive statistics for each diploma level GPA and T-score results from post-secondary readiness tests. Appendix C includes the ACT scores for each school.

Students receiving an honors diploma showed the largest decrease in test scores at both schools. Students tended to show a larger decline in math, with the exception of the students receiving a regular diploma at School B. The increase in scores of regular diploma students in English and math could be a result of the elimination of the regular track grouping of students. At School B beginning in 1996, all students were

heterogeneously grouped into college prep level courses. The increase in math could also stem from the double semester dose of algebra I that many students in the regular diploma track experienced.

Table 4

Descriptive Statistics by Diploma

School	Diploma	Hours Core		Grade Point Average		English Test Score		Math Test Score	
	Year	1995	2000	1995	2000	1995	2000	1995	2000
A (A/B)	Honors	3784	3299	3.26	3.52	66.1	62.3	67.1	63.3
	College Prep	3186	2718	2.73	3.23	51.3	50.1	49.2	47.6
	Regular	2701	2378	2.26	2.48	42.4	41.5	40.2	38.5
	Total	3004	2636	2.55	2.94	50.1	49.1	48.5	46.9
B (4x4)	Honors	3984	3511	3.76	3.35	68.1	58.5	69.5	57.1
	College Prep	3453	2858	2.84	3.12	53.6	50.6	53.9	47.2
	Adv.Comp.	3082	*	2.52	*	45.8	*	44.7	*
	Regular	2606	2698	2.2	2.43	42	44.4	39.4	43.9
	Total	3106	2893	2.61	2.9	50.6	49.5	50	47.4
Total	Honors	3861	3429	3.45	3.42	66.8	60	68.1	59.6
	College Prep	3317	2797	2.78	3.17	52.4	50.4	51.5	47.4
	Regular	2663	2541	2.23	2.46	42.2	43.3	39.9	41.9
	Total	3055	2778	2.58	2.92	50.4	49.3	49.3	47.2

*-Advanced Comprehensive Diploma was offered at School B through 1996

The regression analysis indicates that the amount of time a student spends studying the academic core is a strong predictor of their success on a test of post-secondary readiness. In fact, the step-wise multiple linear regression model indicated that the time spent studying the academic core is a stronger predictor than grade point average or the level of diploma on student achievement scores. The only predictor that is as powerful or more powerful than core hours is the student rank. The results of the analysis for the total sample are consistent with those found for School B. The results are slightly different for School A. Diploma is a much more powerful predictor at School A

than at School B. This could be a result of the system of tracking used at School A. The regression tables are included in Appendix D.

Discussion

This study calls into question the importance of the delivery of curriculum evolving with the implementation of various forms of block scheduling. Many schools implement a block schedule without restructuring the curriculum at the school. Others restructure the school to enable curriculum differentiation to occur on a large scale. The two high schools in this study are characteristic of what happens when two very good high schools make the transition to block. In the case of these schools, the block schedule has created a time shift, rather than a credit shift, away from core academic subjects to elective areas. The regression indicates that this time shift can be harmful to student achievement since the hours spent studying the academic core proves a strong predictor of success on tests like the ACT. While the raw achievement data are mixed, a general decline in test scores is evident in math, especially among students studying a rigorous pre-college curriculum.

The reality of what is happening in block schedule schools such as these runs counter to the results of early versions of block schedule, such as those advocated by Sizer (1984) and Carroll (1990). The major impetus for the block movement is grounded in the increased learning possibilities of students exposed to a curriculum under intensive blocks of time. As many of the time studies and brain research indicate, such blocks of time are compatible with the learning needs of students and promote sound instructional pedagogy. Groups with agendas different than the initial intended structure of block scheduling have found the process to help increase the number of students in various

elective programs. The original intent of block scheduling is now lost to the politics of the differentiated curriculum. Such a result provides only a small percentage of students with the opportunity to master the knowledge and skills that might lead to success in society.

One variable not addressed by this study is the instruction delivered by teachers on the block schedule. Many block supporters contend that the decrease in time is offset by the better instruction that will result from teaching techniques used on block schedules. One serious danger, as cited in Kramer (1996), is that students will learn less and teachers who had previously found success by relying on lecture and student practice may need to adopt a participatory mode of instruction. The extent to which this is occurring is difficult to measure from student achievement data alone. Research to date indicates that making such a change is difficult unless several factors support it, including the availability of staff development and adequate planning time. When these factors are not present, student achievement can suffer. The question remaining is whether the lack of improved student achievement is the result of the decreased time in the academic core or the instructional pedagogy. This study offers the suggestion that a strong academic core, that includes English, math, science and social studies for all students every day of the year, must compliment sound pedagogy for increased achievement.

There are relative merits for each of the two forms of block schedule studied here. The 4 x 4 seems to be the most problematic as far as performance music, journalism and AP classes are concerned. The A/B offers the stability of yearlong instruction, regardless of the diminished time. The results here do not indicate which schedule better

promotes student achievement. The results do, however, illustrate the importance of how a school structures the curriculum within the schedule.

Conclusion

This report is not intended to be an attack on the virtues of block scheduling. It is intended to provide a *caveat* to schools utilizing or considering the implementation of some form of block schedule. Schools that embrace the block for increasing achievement by adjusting the learning time are utilizing the block for the purpose it was intended to serve. The structure of the curriculum delivered to the students is a fundamental component of student academic success on the block. Those embarking on the schedule to give students increased opportunities to take electives are creating an educational version of Gresham's Law[1], where the bad curriculum ultimately drives out the good. The curricular differentiation and increased comprehensive nature of high schools embracing block scheduling are putting aside a rigorous core academic curriculum for student choice and differentiation. The turf battles and politics that will ensue prove to be a setback in the intellectual mission of the American high school.

[1] Gresham's Law refers to the economic concept that bad money drives out good money.

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Appendix A

Graduation Requirements 1995 and 2000

School A Graduation Requirements

Honors Diploma

Subject	1995 Units	2000 Units
English	4	4
Math	3	3
Science	3	3
Health/ PE	1	1
Social Studies	3	3
Fine Arts	0	1
Foreign Language	3	3
Electives	3	10
Total	20	28

College Prep Diploma

English	4	4
Math	3	3
Science	3	3
Health/ PE	1	1
Social Studies	3	3
Fine Arts	0	1
Foreign Language	2	2
Electives	4	11
Total	20	28

Regular Diploma

English	4	4
Math	2	3
Science	2	2
Health/ PE	1	1
Social Studies	2	2
Fine Arts	0	1
Foreign Language	0	0
Electives	5	13
Total	16	26

School B Graduation Requirements

Honors Diploma

Subject	1995 Units	2000 Units
English	4	4
Math	5	4
Science	5	4
Health/ PE	1	1
Social Studies	3	4
Fine Arts	0	0
Foreign Language	2	2
Keyboarding	0	.5
Personal Development	0	.5
Senior Projects	0	.5
Academy Credits	0	4
Electives	2	3.5
Total	22	28

College Prep Diploma

English	4	4
Math	3	4
Science	3	3
Health/ PE	1	1
Social Studies	3	4
Fine Arts	0	0
Foreign Language	2	2
Keyboarding	0	.5
Personal Development	0	.5
Senior Projects	0	.5
Academy Credits	0	4
Electives	4	3.5
Total	20	27

Regular Diploma

English	4	4
Math	2	3
Science	3	2
Health/ PE	1	1
Social Studies	3	3
Fine Arts	0	0
Foreign Language	0	0
Electives	7	13
Total	20	26

Appendix B

Bell Schedules for 1995 and 2000

Bell Schedule
School A

1995		2000	
Channel One	8:11 - 8:23	Channel One	8:15 - 8:30
1st Period	8:23 - 9:21	1st Block	8:30 - 9:59
2nd Period	9:26 - 10:24	2nd Block	10:05- 11:33
Break	10:24-10:34	3rd Block	11:39- 1:37
3rd Period	10:34-11:32	Break	1:37 - 1:47
4th Period	11:37- 1:05	4th Block	1:47- 3:15
5th Period	1:10 - 2:08		
Break	2:08 - 2:18		
6th Period	2:18 - 3:16		

School B

1995		2000	
Channel One	8:11 - 8:23	1st Block	8:18 - 9:45
1st Period	8:23 - 9:21	Break	9:45 - 9:58
2nd Period	9:26 - 10:24	2nd Block	9:58-11:25
Break	10:24-10:34	3rd Block	11:32- 1:39
3rd Period	10:34-11:32	Break	1:39 - 1:49
4th Period	11:37- 1:05	4th Block	1:49 - 3:16
5th Period	1:10 - 2:08		
Break	2:08 - 2:18		
6th Period	2:18 - 3:16		

Appendix C

ACT Scores from 1995 to 2000

Table C.1

ACT Score Comparisons from 1995 and 2000 from Both High Schools with Sample Group and Total School Population

School A (A/B)					
		Sample Group			
		English		Mathematics	
Year	N	M	SD	M	SD
Class of 1995	46	21.0	5.5	19.9	5.4
Class of 2000	43	20.5	5.3	19.8	2.3
		Total School Population			
Class of 1995	197	20.9	5.7	20.0	5.4
Class of 2000	208	19.8	5.3	19.5	4.6

School B (4 x 4)					
		Sample Group			
		English		Mathematics	
Year	N	M	SD	M	SD
Class of 1995	63	21.6	5.0	21.3	5.2
Class of 2000	59	21.5	4.8	20.2	3.9
		Total School Population			
Class of 1995	208	20.8	5.0	20.5	5.1
Class of 2000	241	20.8	5.6	19.9	4.6

Table C.2

ACT Scores by Quartile Values for Total School Populations of Both High Schools

Quartile	School A			
	English		Mathematics	
	1995	2000	1995	2000
Q3 (75th)	25.2	23.1	23.3	22.3
Q2 (Median)	20.5	19.8	18.4	18.8
Q1 (25th)	16.3	15.7	16.0	16.1
	School B			
Q3 (75th)	24.5	24.5	23.8	22.5
Q2 (Median)	20.5	20.7	19.3	18.7
Q1 (25th)	17.1	16.8	17.1	16.4

Appendix D

Regression Analysis Tables

Table D.1

Summary of Multiple Linear Regression Analysis for Variables Predicting Student Performance on ACT English Scores for Sample Graduates from 1995 and 2000 at Both High Schools

Variable	B	SE B	β
Step 1			
Rank	-3.91	.461	-.652**
Step 2			
Rank	-2.96	.003	-.495**
Core Hours	3.71	.000	.382**
Step 3			
Rank	-1.48	.006	-.247*
Core Hours	4.24	.001	.437**
GPA	2.41	.880	.263**

Note. R_2 = .43 for Step 1; ΔR_2 = .54 for Step 2; ΔR_2 = .55 for Step 3 (ps < .05).
**p < .01; *p < .05

Table D.2

Summary of Multiple Linear Regression Analysis for Variables Predicting Student Performance on ACT Math Scores for Sample Graduates from 1995 and 2000 at Both High Schools

Variable	B	SE B	β
Step 1			
Rank	-3.93	.003	-.694**
Step 2			
Rank	-3.09	.003	-.544**
Core Hours	3.35	.000	.364**
Step 3			
Rank	-1.80	.006	-.316**
Core Hours	3.81	.000	.414**
GPA	2.10	.793	.242**
Step 4			
Rank	-1.44	.006	-.254*
Core Hours	3.43	.000	.374**
GPA	1.93	.788	.221*
Diploma	-.691	.298	-.143*

Note. R_2 = .48 for Step 1; ΔR_2 = .59 for Step 2; ΔR_2 = .60 for Step 3; ΔR_2 = .61 for Step 4 (ps < .05).
**p < .01; *p < .05

Table D.3

Summary of Multiple Linear Regression Analysis for Variables Predicting Student Performance on English T-Scores for Sample Graduates from 1995 and 2000 at Both High Schools

Variable	B	SE B	β
Step 1			
Rank	-7.23	.005	-.680**
Step 2			
Rank	-5.47	.005	-.512**
Core Hours	6.91	.001	.373**
Step 3			
Rank	-3.15	.010	-.294*
Core Hours	4.24	.001	.419**
GPA	2.41	.880	.227*

Note. R_2 = .46 for Step 1; ΔR_2 = .57 for Step 2; ΔR_2 = .58 for Step 3 (ps < .05).
**p < .01; *p < .05

Table D.4

Summary of Multiple Linear Regression Analysis for Variables Predicting Student Performance on Math T-Scores for Sample Graduates from 1995 and 2000 at Both High Schools

Variable	B	SE B	β
Step 1			
Rank	-7.57	.005	-.683**
Step 2			
Rank	-5.66	.005	-.510**
Core Hours	7.38	.001	.384**
Step 3			
Rank	-4.52	.006	-.407**
Core Hours	6.46	.001	.337**
Diploma	-1.65	.583	-.174**

Note. R_2 = .47 for Step 1; ΔR_2 = .58 for Step 2; ΔR_2 = .59 for Step 3 (ps < .05).
**p < .01; *p < .05

Table D.5

Summary of Multiple Linear Regression Analysis for Variables Predicting Student Performance on ACT English Scores for Sample Graduates from 1995 and 2000 at High School A

Variable	B	SE B	β
Step 1			
Rank	-5.68	.005	-.785**
Step 2			
Rank	-4.80	.005	-.664**
Core Hours	3.23	.001	.306**

Note. R_2 = .61 for Step 1; ΔR_2 = .69 for Step 2 (ps < .05).
**p < .01; *p < .05

Table D.6

Summary of Multiple Linear Regression Analysis for Variables Predicting Student Performance on ACT Math Scores for Sample Graduates from 1995 and 2000 at High School A

Variable	B	SE B	β
Step 1			
Diploma	-5.96	.515	-.779**
Step 2			
Diploma	-3.60	.691	-.470**
Rank	-2.81	.006	.416**

Note. R_2 = .61 for Step 1; ΔR_2 = .68 for Step 2 (ps < .05).
**p < .01; *p < .05